Partial Oxidation for Improved Cold-Start in Alcohol Fueled Engines

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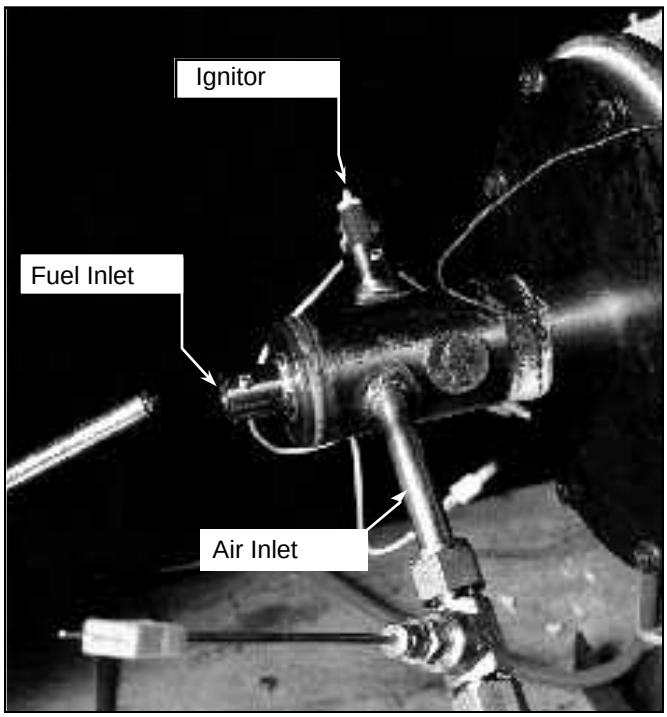
Objective

To develop a compact partial oxidation (POX) reactor as a fuel system component that will dramatically improve cold startability and reduce cold-start emissions for neat-alcohol-fueled engines.

Approach

An experimental program is underway to develop a prototype POX reactor for a light-duty ethanol-fueled engine. During Phase I, we verified the feasibility of using ethanol partial oxidation products to improve cold starts. Scoping experiments, which used blended bottled gases to simulate POX products, assessed start performance and determined fueling requirements for this cold-start strategy. A simple prototype POX reactor was built and tested to verify its ability to produce the required cold-start fuel. In Phase II, we will design, fabricate, and test a compact, POX cold-start system on a 3.1-liter Chevrolet Lumina engine. Experiments will be conducted on the integrated system to measure start performance and emissions under a variety of realistic engine cold-start conditions. Results will be used to improve the prototype cold-start system design, with emphasis on being compatible with modern ethanol vehicle technology.



Ethanol oxidation cold start system

Accomplishments

During Phase I, rapid engine starts (<5 seconds) and transition to sustained idle at very cold temperatures (-30°C) was demonstrated. This was achieved by starting the engine with simulated POX products and transitioning to E95 only over a 10- to 20-second time period. Total hydrocarbon and carbon monoxide emissions were reduced by more than an order of magnitude during the

first 90 seconds of engine operation when simulated POX products were used during engine cold starts instead of E95. Testing also demonstrated the wide ignition limits of typical POX product fuel species under engine cold-start conditions (down to -30°C). From the test results, an extremely simple and compact prototype POX reactor was designed, fabricated, and tested independently from the engine.

Future Direction

Phase II work is currently underway. During this phase, the design, fabrication, and testing of a prototype POX cold-start system will be completed. Evaluation of the prototype POX reactor will include developing performance characteristics for the engine/POX system. Optimization of the prototype system will be performed, focusing on the emission characteristics of the engine and the engine cold-start characteristics

Publications

None to date.